Understanding the LFO2 Module and MIDI Implementation

The LFO2 module on your Voyager XL is a very powerful and flexible sonic tool to extend your modulation capabilities in many ways. The primary use of the module from the front panel is described very well in the Voyager XL manual; however, we would like to take the opportunity to describe it in more depth and to explain some of its more advanced features and MIDI capabilities.

PRIMARY FUNCTION

The LFO2 module is primarily designed to *augment* the standard LFO sources on the Voyager. Thus the standard front-panel rate is designed to be *slower* than the Voyager LFO allowing you to add slower modulations than previously available.

Using the front panel RATE knob, you can control the LFO frequency as shown:

0.02 Hz (50 seconds) to 20Hz (0.05 seconds)

There are three standard outputs for the LFO2 module. The first two are available on the LFO2 module and are labeled LFO(+) and LFO(-). These are *complementary* outputs which means that LFO(-) is always the complement of LFO(+).

If a voltage on LFO(+) swings from -5V to +5V, then the voltage on LFO(-) swings from +5V to -5V. If the voltage on LFO(+) is +2.4V, then the voltage on LFO(-) is -2.4V.

Complementary LFOs allow you to create some very interesting sonic effects, since while one CV is *increasing*, the complement is *decreasing*.

The RATE LED is always reflecting the state of the LFO(+) output.

ATTENUATOR CHANNEL 1: LFO(+) OUTPUT

Additionally, you can access the LFO(+) output directly from the output of ATTENUATOR Channel 1 when nothing is connected to the input of this channel. In other words, the output of Channel 1 is *normalled* to LFO(+).

This is very useful to control the RANGE and AMPLITUDE of the LFO waveform before sending it to your destination. This allows you to both *play* the LFO dynamically by adjusting the OFFSET and AMOUNT on the Attenuator, but also to be able to dial in the most musical window of the destination CV that the LFO is modulating.

EXTERNAL RATE CV

On the front panel of the LFO2 Module is a jack input labeled "RATE CV". This allows you to connect an *additional* control-voltage (0V to 5V range) to further control the rate of the LFO2 module.

The external RATE CV and the front panel RATE CV are *additive* which means that they work seamlessly together to create a full CV control range of 0V to 10V, each control adding a 5V range separately. For example, if the external RATE CV is 1.5V and the front-panel RATE CV is 2.4V, then the final RATE CV is set to 3.9V. The total CV voltage is capped at 5V keeping the maximum front panel frequency range to 20Hz (see table below).

Understanding the LFO2 Module and MIDI Implementation

Note: The External RATE CV jack is ring-powered which means that you can attach an expression pedal to the jack and control the LFO2 RATE via this pedal as well as plugging in an active control-voltage source with a 0V to +5V range.

RATE EXAMPLES

RATE KNOB	RATE CV INPUT	FREQUENCY	PERIOD
0V (CCW)	0V (no input)	0.02 Hz	50 seconds
5V (CW)	0V (no input)	20 Hz	0.05 seconds
0V (CCW)	5V	20 Hz	0.05 seconds
5V (CW)	5V	20 Hz (*)	0.05 seconds

(*) Any CV sum greater than 5V will be limited to 5V internally

As you can see from the table above, LFO2 can both be used to extend the modulation rates to very slow rates (i.e. slower than the Voyager LFO module). Faster audio-rate modulation is available on the Voyager via the standard sources internally (for example using Oscillator 3 as an LFO source) or externally by patching in audio-rate devices into the XL's CV IN patch panel.

EXTERNAL CLOCK

There is also an EXT. CLOCK jack on the LFO2 module. When nothing is connected to the CLOCK jack, the LFO2 module is either free-running or sync'd to MIDI clock (explained later). Using the CLOCK input, the LFO2 module can also be directly *triggered* from an external clock (or GATE) source.

> *Please note that the CLOCK input needs an active signal such as the KBD GATE CV available from the CV OUTPUT section. It requires a 0V to 5V gate source. Passive footswitches will not work with this input.*

External clocking of the LFO2 module allows you to single trigger LFO events as well as synchronize the LFO2 to other timing sources. The "envelope" time of the clocked pulse will still be determined by the RATE parameters. For example, if your RATE is currently set to 1Hz and your waveform is TRIANGLE, you will be one cycle of triangle every time you clock the LFO2 module (i.e. the triangle period will be one-second but will not retrigger). Clocking the LFO more frequently than the LFO period is fine – it will just retrigger the waveform from the current voltage.

MIDI IMPLEMENTATION

The LFO2 module has a basic set of MIDI features that further extends your ability to work with the LFO2 module and to interconnect and synchronize it to external sources such as DAW's, other MIDI devices, or controllers like the Moog MP-201 Multi-Pedal.

The LFO2 MIDI input is shared with the main Voyager MIDI input port. The default MIDI channel is **1**. The main Voyager engine and the LFO2 module do not share common MIDI CC's so they can both occupy the same MIDI channel. Alternatively, both the main Voyager engine and the LFO2 module can have their MIDI channels assigned. The LFO2 module's MIDI channel will always default to channel 1 when powered-up.

Understanding the LFO2 Module and MIDI Implementation

MIDI SYNC

MIDI SYNC (or RTC CLOCK) is channel independent. When the LFO2 module detects the start of a MIDI RTC CLOCK stream, it starts measuring the time interval between clocks. All other RATE determinates are overridden and the LFO2 automatically synchronizes to the CLOCK. At this point, the SYNC LED will illuminate a solid AMBER color.

While in MIDI SYNC, the CLOCK_DIVISOR is determined by three controls:

- MIDI CC94: MASTER CLOCK DIVISOR (*refer to the manual pg. 79 for more information on this CC)*
- FRONT PANEL RATE KNOB
- EXT. RATE CV INPUT

Turning the front panel RATE knob on the LFO2 module during MIDI SYNC adjusts the clock divider going from 4 WHOLE NOTES (all the way CCW) to 1/64th NOTES (all the way CW). This covers the same range as the MIDI CC94.

You can also adjust the clock divisor by using an external control voltage in the RATE CV jack on the front of the LFO2 module. Again, the RATE CV and the front panel RATE knob are *additive.* The final clock divisor is determined by the *sum* of these two voltages. Note, however, that the sum is capped at "5V", or the fastest clock-divisor of 1/64th notes.

Using the RATE CV is a fun way to play the LFO RATE while in MIDI SYNC mode. For example, you could take the RIBBON CV output and plug it into the RATE CV input. Now you can manipulate the LFO2 rate using the ribbon controller, but the rate will always be sync'd and a multiple of the MIDI CLOCK making for some very interesting rhythmic variations.

> *(Remember: the RATE CV input on the LFO2 module is a 0V to 5V input. To use a bipolar CV output like the Ribbon CV, you must first modify the ribbon CV to be unipolar. You can easily do this by using the ATTENUATOR CH.2 output and adjusting the AMNT and OFFSET to scale -5V to +5V to 0V to 5V or any other scale you want.)*

Sending a MIDI CC94 to the LFO2 module will override the last *active* RATE CV-determined clock divisor.

MIDI SYNC ENABLE

The Voyager XL always powers-up with LFO2 MIDI SYNC enabled, meaning that LFO2 will always default to MIDI SYNC mode any time MIDI CLOCK messages are received. MIDI CC 111 allows you to control this behavior: MIDI CC 111, value 0-63 disables MIDI SYNC for LFO2. If MIDI SYNC is disabled, the LFO2 module will ignore MIDI CLOCK and will run freely at its internal rate even when Clock messages are present. MIDI CC 111, value 64-127 will enable MIDI SYNC again.

MIDI MASTER RATE

Sending a MIDI CC92 to the LFO2 module will set the MASTER RATE of the LFO2 outputs. This allows you to manually set the LFO2 rate remotely. Standard MIDI CC resolution is 7-bits, values of 0-127 are allowable to sweep from 0.02Hz to 20Hz.

Understanding the LFO2 Module and MIDI Implementation

MIDI WAVEFORM TYPE

The LFO2 module has six waveforms available from the front panel as documented in the manual. These waveforms can also be changed via MIDI CC95: LFO2 MASTER WAVEFORM. Please refer to the manual page 79 for a reference to the actual CC definitions.

From MIDI CC95, one can select the six waveforms from the front panel and additionally a **SINE** waveform. (The last waveform via MIDI is reserved for future use.)

Sending a MIDI CC95 to the LFO2 manual will change the waveform for *both* the LFO(+) and the LFO(-) outputs of the module.

Additionally, one can control the waveforms of LFO(+) and LFO(-) separately via MIDI only. This gives the LFO2 module a great degree of flexibility and deepens the types of signals you can generate with the module. *Please note that the phase relationship of the two LFO's are always preserved.* This means that the rates of both LFO's are always identical and that the time relationship between each LFO (phase) is also preserved. Thus, even when you change the waveform *type*, the waveforms remain complementary in phase.

Changing individual waveforms via MIDI is done using the following two MIDI CCs:

- MIDI CC105: LFO(+) WAVEFORM TYPE
- MIDI CC109: LFO(-) WAVEFORM TYPE

Changing the waveforms using the MIDI CC95 or the front panel switch, immediately resets the LFO(+) and LFO(-) outputs to be the same waveforms and true complements of each other.

UNIMPLEMENTED MIDI CCs

As per the manual, page 79, there are a number of LFO2-related MIDI CC's that are *not implemented* but defined on the instrument so that these remain reserved for future use.
Currently these are CC102, CC103, CC104, CC106, CC107, and CC108.

DEFINING MIDI CHANNEL

The LFO2 module ALWAYS comes up defined as MIDI Channel 1 when you power-up your Voyager XL.

Care must be taken not to create MIDI CC conflicts with any other MIDI device that is attached to the MIDI chain. It is best to set other devices to channels 2-16.

If you are in a situation where you need to use MIDI CHANNEL 1 for another device in the MIDI chain, you can reassign the LFO2's internal MIDI channel by sending a MIDI CC110: MIDI CHANNEL NUMBER. (Note: you can change the Voyager XL's main MIDI channel from the main user interface.)

MIDI CC110 is handled by the LFO2 module independent of which channel it is being sent on. So, for example, to change the LFO2 MIDI CHANNEL from 1 (default) to 5 you would send a MIDI CC110 with a value of 5. After sending this, the LFO2 module will only respond to MIDI that is sent to channel 5.

NOTES:

- *The newly assigned MIDI CHANNEL is not preserved when you power-down your Voyager XL. If you are not set up to use the default MIDI CHANNEL 1 for your LFO2 module, you will need to remember to reassign this using CC110 every time you power-up your XL. For this reason, we recommend always using MIDI CHANNEL 1 for communication with the LFO2 module.*

- *Care must be taken that other MIDI devices on the chain are not also using CC110 for their own uses. CC110 was chosen because it is a rarely used high number CC so it will not often create conflicts. If you are having MIDI communication issues with your LFO2 module however and have other MIDI instruments in the same chain, you may want to determine if this device is sending CC110 messages.*

  You can also monitor this by looking at the SYNC on the LFO2 module which indicates MIDI activity being accepted by the LFO2 module (including MIDI CLOCK). This LED should blink briefly only when it is handling MIDI messages on the channel it is currently assigned to except for MIDI CC110. If you are seeing this LED blink even when there are messages that aren't sent to the current MIDI channel, you should check to see if something else is sending a CC110 message.